

In re Patent Application of:

DOHLE ET AL

Serial No. **10/732,777**

Filed: **DECEMBER 10, 2003**

IN THE DRAWINGS:

Attached are three replacement sheets containing amended Figures 1A-C, 2 3, 4, and 5, as explained in the accompanying remarks section.

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REMARKS

Claims 1 to 9 are currently pending.

Claims 1, 3, 4 and 8 have been rejected under 35 U.S.C. 103(a) in view of United States Patent No. 4,879,589 (Saint-Cyr) in combination with United States Patent No. 5,614,736 (Neumann).

Claim 2 has been rejected under 35 U.S.C. 103(a) in view of Saint-Cyr in combination Neumann and United States Patent No. 3,622,906 (Nyul).

Claim 5 has been rejected under 35 U.S.C. 103(a) in view of Saint-Cyr in combination with Neumann and United States Patent No. 5,812,570 (Spaeth).

Claim 6 has been rejected under 35 U.S.C. 103(a) in view of Saint-Cyr in combination with Neumann and United States Patent No. 4,666,569 (Basol).

Claim 7 has been rejected under 35 U.S.C. 103(a) in view of Saint-Cyr in combination with Neumann and Basol and further in view of Spaeth.

The drawings have been objected to under 37 CFR 1.84(5) for including reference characters not mentioned in the description. The drawings are further objected to for ambiguity in the use of a reference numeral on two different figures.

The drawings have been objected to under 37 CFR 1.83(a) for failing to show every feature of the invention specified in the claims.

The drawings have been amended to overcome the objections of the Examiner.

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The claims of the application have been amended to overcome the objections of the Examiner and to better define the invention in light of the prior art. In particular, claim 1 has been amended to define a planar contact structure, with particular attention drawn to the original claim language "have an overall thickness such that the contact structure has an effective CTE that matches the CTE of the semiconductor component more closely than either the second CTE or the first CTE..." New claim 9 defines a selected thickness for optimizing the electrical resistive constant of the contact structure.

The specification has been amended at paragraphs [19] and [35] to correct errors noted by the Examiner.

The specification has been further amended at paragraphs [18], [26], and [39] in order to bring the specification into accord with required amendments to the figures. Specifically paragraph [18] has been amended to define the P-side and N-side of the semiconductor laser subassemblies. Support for this amendment can be found in original claim 1, background paragraph [5] and figure description [12]. Paragraph 26 has been amended to correct the numerals with respect to amended Figures 3, 4 and 5. Further amendment incorporating the claim language "the layers of the second material" of original claim 1 has been added. Paragraph [39] has also been amended to bring the specification into accord with the amendments to Figures 4 and 5.

Claim 1 has been rejected in view of Saint-Cyr and Neumann, the contribution of Neumann being to positively state the P and N sides of the semiconductor component as generally understood in the art.

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Saint-Cyr addresses a problem in the prior art, that copper contacts have a poor thermal match to the semiconductor diode and suffer stress to the diode or delamination. Copper has a CTE of approximately 17 ppm/C compared to a typical semiconductor such as GaAs, which has a CTE of approximately 5.7 ppm/C or InP, which has a CTE of approximately 4.6 ppm/C. The solution proposed by Saint-Cyr is to use molybdenum contacts, which have a CTE of approximately 5.1 ppm/C. These molybdenum contacts are better matched in terms of CTE to GaAs or InP, compared to copper; however, ohmic contact to the semiconductor cannot be made directly to molybdenum. Saint-Cyr therefore proposes to laminate the contact with a thin layer of copper. "The thin copper film assures an ohmic contact with the device, but it is so thin that the thermal expansion properties of the contact is essentially that of the molybdenum itself, which matches the thermal expansion properties of the device sufficiently to avoid delamination," col. 2 lines 6-11.

Saint-Cyr discloses a J-shaped spring with sufficient stiffness to assist in maintaining contact with the semiconductor device. Accordingly, the contact thickness of the Saint-Cyr device is orders of magnitude greater than the present invention. The contact of the present invention is a foil, having for example a thickness of 0.010 cm.

Saint-Cyr emphasizes repeatedly, in the quote above (col.2, lines 6-11) and in claims 2 and 6, "wherein said spring contact is formed from a metal having a coefficient of thermal expansion closely matching the coefficient of thermal expansion of said semiconductor diode, and a thin copper film

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over said metal to facilitate making an ohmic contact with said semiconductor diode", that a CTE matching metal is selected for the contact structure and a film of copper is necessary to provide ohmic contact. The relationship of these thicknesses, with many orders of magnitude difference between them, as demonstrated by the equation in paragraph [29] of the present application, assures that the CTE will be dominated by the CTE of the thick layer.

It has been argued in the Office Action that, "it was well within the skills of an artisan in the art to optimize the performance of a second component by adjusting the thickness in order to provide a reliable contact structure which avoids delamination, and whose thermal expansion properties are matched with a diode."

Such an observation cannot be supported by the prior art. There is no suggestion of balancing the thicknesses of the two materials to modify the effective CTE of the contact structure; nor any suggestion that a closer CTE match may be necessary or desirable. Given the very large difference in thicknesses of the Saint-Cyr components, the "adjustment" to the thickness of the second component in order to affect the CTE would have implications for the structural performance and cost of the structure, which would go well beyond the teaching of the Saint-Cyr reference. So large an "adjustment" would be well beyond the range of experimental "optimization".

A "sufficient" CTE match for the Saint-Cyr single semiconductor device with a spring biased contact and spacing all around the device, is not sufficient, for instance, for a

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laser stack in which multiple devices each producing significant heat are in contact with each other.

The present invention teaches and claims, selecting two materials for the contact structure such that the CTE of the semiconductor is intermediate to the CTE of the two materials, as disclosed in paragraph [37] and original claim 1. The purpose of the present invention is to engineer a better CTE match to the underlying semiconductor material than is known in the prior art. The contact is claimed as having "an overall thickness such that the contact structure has an effective CTE that matches the CTE of the semiconductor component more closely than either the second CTE or the first CTE..." This cannot be said of the prior art, nor would it be considered within a reasonable experimental range of the teaching of the prior art. In employing a thin planar structure, the CTE can be more closely matched than the prior art, which relies on a "sufficiently" close CTE of molybdenum. In addition, the electrical resistivity can be optimized to improve performance and heat properties.

Applicant submits that the advantages of claims 1, 3, 4 and 8 cannot be found in the teaching of Saint-Cyr in combination with Neumann. Regarding claim 4 in particular, the relationship of thicknesses claimed and disclosed in the present invention as compared to the teaching of Saint-Cyr cannot be said to be within a range of experimental optimization, being many orders of magnitude of difference. There is nothing obvious in such a modification. The claimed structure and its properties are in no way similar to those of Saint-Cyr.

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Claim 2 is rejected as obvious in view of Saint-Cyr in combination with Neumann and Nyul. Nyul discloses a stair stepped structure in order to more effectively dissipate heat. As such, Nyul provides further evidence of the inventive nature of the contact structure of the present invention, which more precisely matches the thermal properties of the diodes enabling a more compact stack structure.

Claim 5 has been rejected in view of Saint-Cyr in combination with Neumann and Spaeth. As dependent on an allowable independent claim 1, this claim cannot be obvious.

Claim 6 has been rejected in view of Saint-Cyr in combination with Neumann and Basol. Basol supports the teaching of Saint-Cyr also employing a thin copper layer to provide stable ohmic contact. The combination of these references certainly does not suggest a many magnitude increase in copper thickness to modify the CTE. A copper/silver laminate is disclosed by Basol, which would not favorably modify the CTE. Claim 6 claims a silver / molybdenum / silver laminate.

Claim 7 has been rejected in view of Saint-Cyr in combination with Neumann and Basol and further in view of Spaeth. The advantages of the present invention as claimed in independent claim 1 combined with dependent claim 7 are not disclosed in the combination of these four references.

It is respectfully submitted that all of the claims in the application are in condition for allowance. Early and favorable consideration would be appreciated.

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Should any minor informalities need to be addressed, the Examiner is encouraged to contact the undersigned attorney at the telephone number listed below.

Please charge any shortage in fees due in connection with the filing of this paper, including Extension of Time fees, to Deposit Account No. 50-1465 and please credit any excess fees to such deposit account.

Respectfully submitted,



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CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: M/S AMENDMENT, COMMISSIONER FOR PATENTS, PO BOX 1450, ALEXANDRIA, VA 22313-1450, on this 21 day of June, 2005.

